10 MW MULTI BEAM KLYSTRON

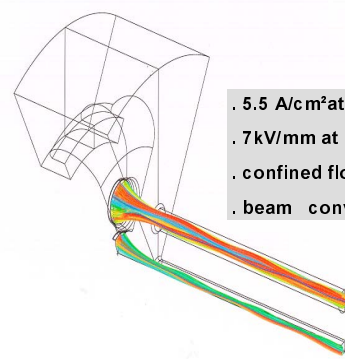
A. BEUNAS R. MARCHESIN G. LECLOAREC / TED/

MULTI BEAM KLYSTRON

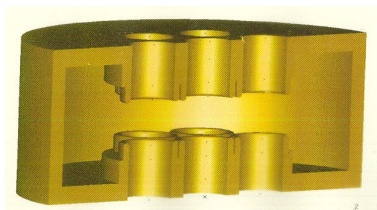
One of the parameters which determines the efficiency of a klystron is the perveance defined as $p = I/U^{3/2}$,where U is the klystron cathode voltage and I the current. For a perveance of $2.10^{-6}A/V^{3/2}$ the efficiency is typically 45%, whereas at 0.5 $10^{-6}A/V^{3/2}$, efficiency of 70% is theoretically achievable. This is due to the lower space charge forces witch enables strong beam bunching and consequently higher efficiency.
The RF power of long pulse single beam klystrons is limited by the high voltage the gun can withstand. To limit the cathode high voltage, the perveance of these conventional klystrons is closed to the maximum practical value of $2.10^{-6}A/V^{3/2}$.
To increase the current and then the power, the **multi beam concept** is to use several low perveance parallel beams.
These beams propagate in separated drift tubes and interact with the RF field of the common cavities they travel through.
The advantage of this solution is the **lower voltage** required and the **higher efficiency** compared to the single beam klystron.

MAIN DESIGN PARAMETERS

- 7 low perveance beams 0.5 µPerv
- Long pulse gun design 1.5 ms
- Multi-cathode diode gun (M type cathodes)
- 6 cavities interaction structure
- 2 output wave guides WR650
- Same technology as conventional klystron



. 5.5 A/cm²at 10 MWp
. 7kV/mm at 120 kV
. confined flow
. beam convergence = 9

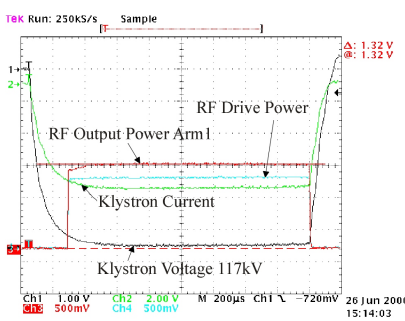


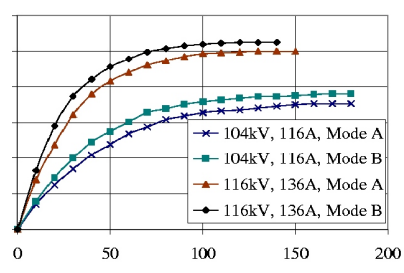
. Toroidal multi-gap cavity
. fundamental mode
. tunable cavities

Multi-cathode gun

MEASURED PERFORMANCES

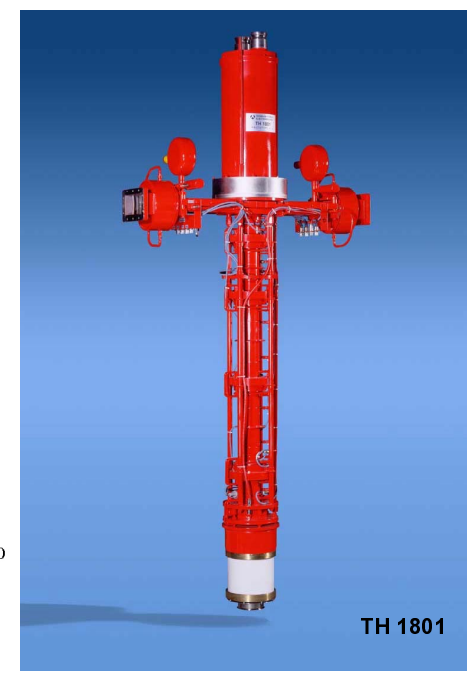
Cathode Voltage	114-116	kV	
Beam Current	134-136	A	
Perveance	3.3-3.5	µPerv	
Output RF Peak Power	10	MW	
Output RF Average Power	150	kW	500µs x 30 Hz Factory
Output RF Average Power	150	kW	1500µs x 10 Hz DESY
Efficiency	65	%	
Drive RF Peak Power	140	W	
Gain	48.5	dB	
Electromagnet power	5.5	kW	





RF Output power versus RF drive power
Mode A : VSWR = 1
Mode B : VSWR =1.2

3 TUBES DELIVERED TO DESY



➤**Gun design improvement under progress to minimize gun arcing occurrence**

THALES

RF 02